

# The Developing La Niña and the Outlook for September, October and November 2010 For Northeast Colorado

Mike Baker  
National Weather Service  
Boulder, Colorado



A satellite image of Earth from space, showing the Americas and the surrounding oceans. The text "Status of La Niña" is overlaid in red. The image shows the Western Hemisphere, with North and South America visible. The Pacific Ocean is to the west, and the Atlantic Ocean is to the east. Cloud patterns are visible over the oceans.

# Status of La Niña

# Overview

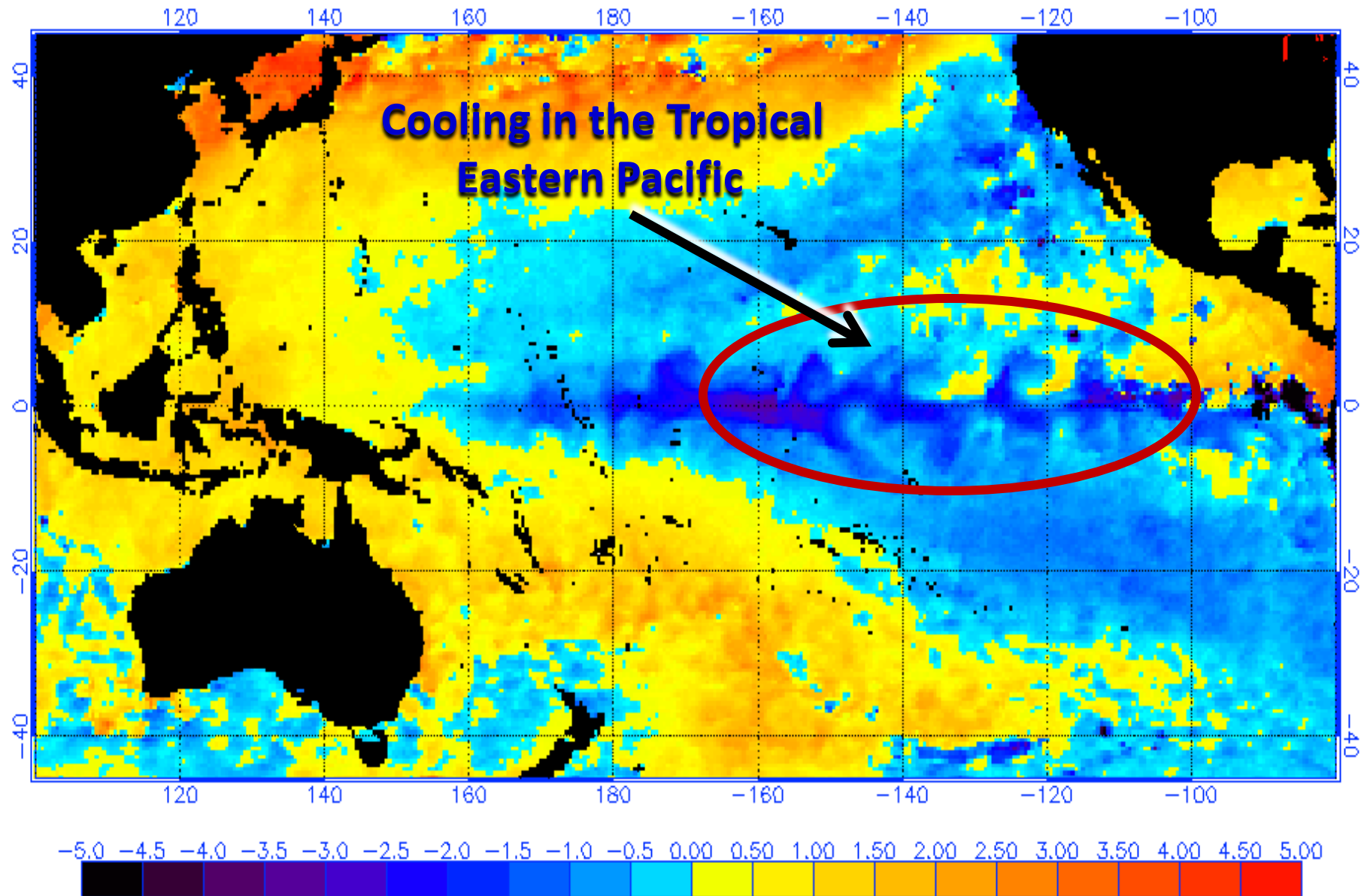
- **La Niña conditions have developed in the eastern tropical Pacific Ocean.**
- **Sea surface temperatures (SSTs) in the tropical Pacific from near the International date line to the west coast of South America have remained below average for the past few months.**
- **Recent Equatorial Pacific SST trends and model forecasts indicate La Niña will strengthen in the next few months and continue at least through the Northern Hemisphere winter of 2010-2011.**



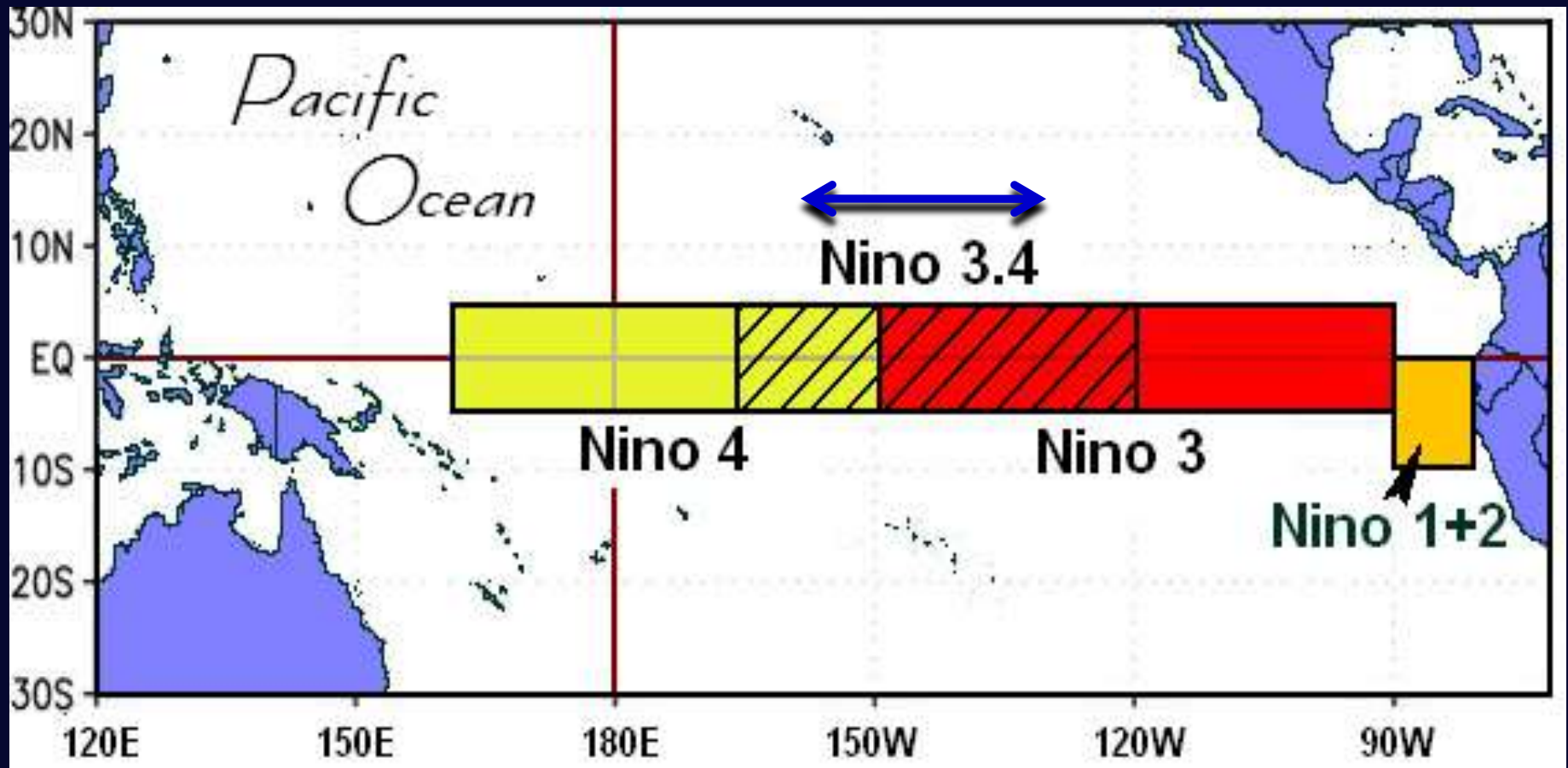
## Overview

- **However, there is disagreement among the models over the eventual strength of this La Niña. Approximately half of the models (dynamical models) predict a moderate-to-strong La Niña, while the remaining (statistical) models indicate a weaker episode.**
- **Given the strong cooling observed in the eastern Pacific over the last few months and the apparent ocean-atmosphere coupling (positive feedback), the dynamical model outcome of a moderate-to-strong episode is favored at this time.**

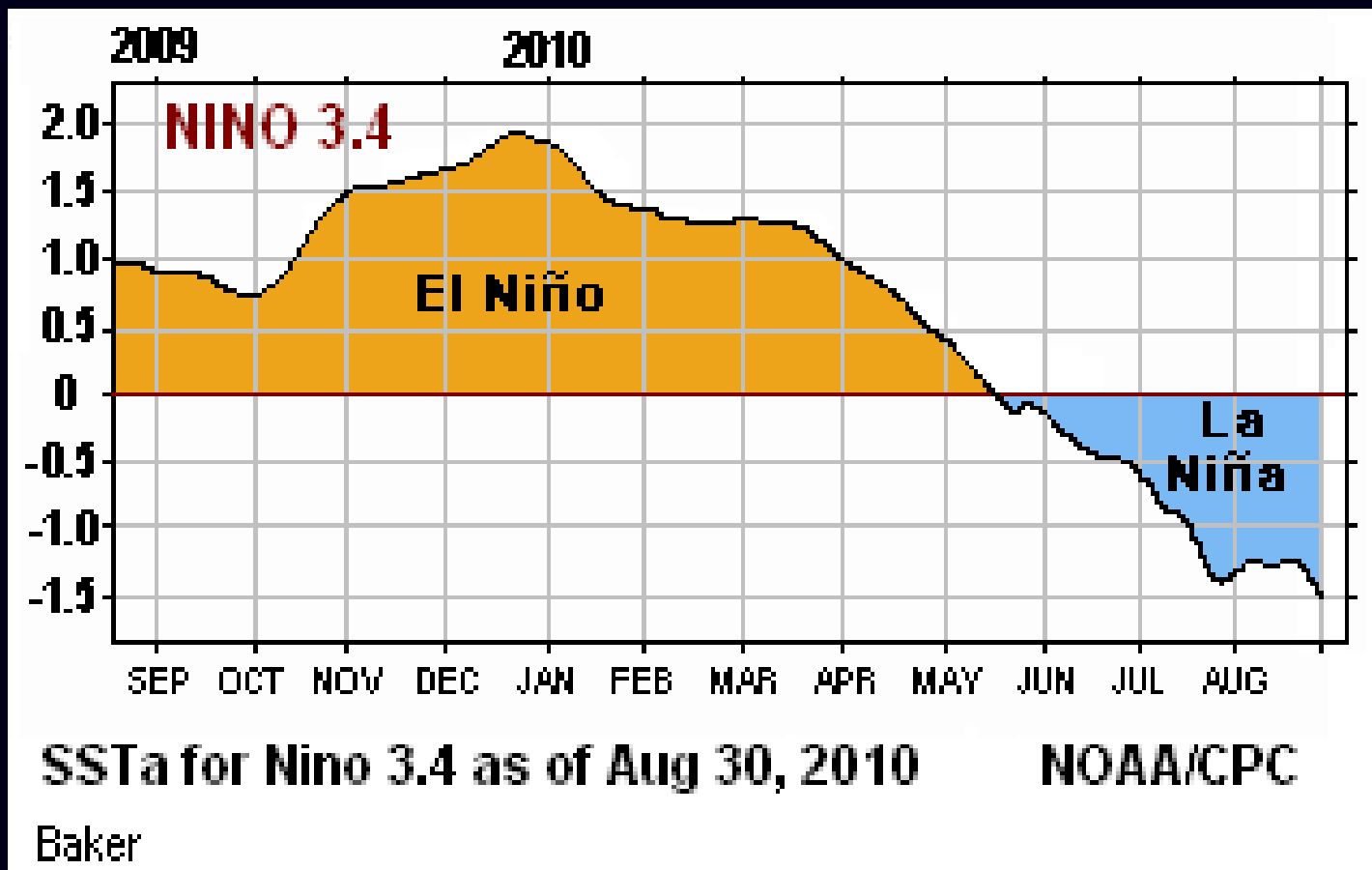
NOAA/NESDIS SST Anomaly (degrees C), 8/26/2010



# Niño Regions in the Tropical Pacific Ocean



**Niño 3.4 – The principal region in the eastern tropical Pacific used by the Climate Prediction Center (CPC) for monitoring, assessing and predicting ENSO.**



Abnormally warm sea surface temperatures (SSTs) during the winter and spring of 2009-2010 were quickly replaced by anomalously cool temperatures in June and July. The large negative anomalies observed this summer are consistent with the development of a La Niña. As of August 30th, the average SSTa for Niño 3.4 Region was  $-1.5^{\circ}\text{C}$ .

# Oceanic Niño Index (ONI)

- The **ONI** is based on SST departures from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing, and predicting ENSO.
- Defined as the three-month running-mean SST departures in the Niño 3.4 region.
- Used to place current events into a historical perspective
- **NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.**



# NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a **positive** ONI greater than or equal to +0.5 C.

La Niña: characterized by a **negative** ONI less than or equal to – 0.5 C.

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

*CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed +/- 0.5°C along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.*

# Oceanic Niño Index - ONI

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2000	-1.6	-1.4	-1	-0.8	-0.6	-0.5	-0.4	-0.4	-0.4	-0.5	-0.6	-0.7
2001	-0.6	-0.5	-0.4	-0.2	-0.1	0.1	0.2	0.2	0.1	0	-0.1	-0.1
2002	-0.1	0.1	0.2	0.4	0.7	0.8	0.9	1	1.1	1.3	1.5	1.4
2003	1.2	0.9	0.5	0.1	-0.1	0.1	0.4	0.5	0.6	0.5	0.6	0.4
2004	0.4	0.3	0.2	0.2	0.3	0.5	0.7	0.8	0.9	0.8	0.8	0.8
2005	0.7	0.5	0.4	0.4	0.4	0.4	0.4	0.3	0.2	-0.1	-0.4	-0.7
2006	-0.7	-0.6	-0.4	-0.1	0.1	0.2	0.3	0.5	0.6	0.9	1.1	1.1
2007	0.8	0.4	0.1	-0.1	-0.1	-0.1	-0.1	-0.4	-0.7	-1	-1.1	-1.3
2008	-1.4	-1.4	-1.1	-0.8	-0.6	-0.4	-0.1	0	0	0	-0.3	-0.6
2009	-0.8	-0.7	-0.5	-0.1	0.2	0.6	0.7	0.8	0.9	1.2	1.5	1.8
2010	1.7	1.5	1.2	0.8	0.3	-0.2	?					

Warm Episodes - El Niños (in RED): ONI 0.5 and above

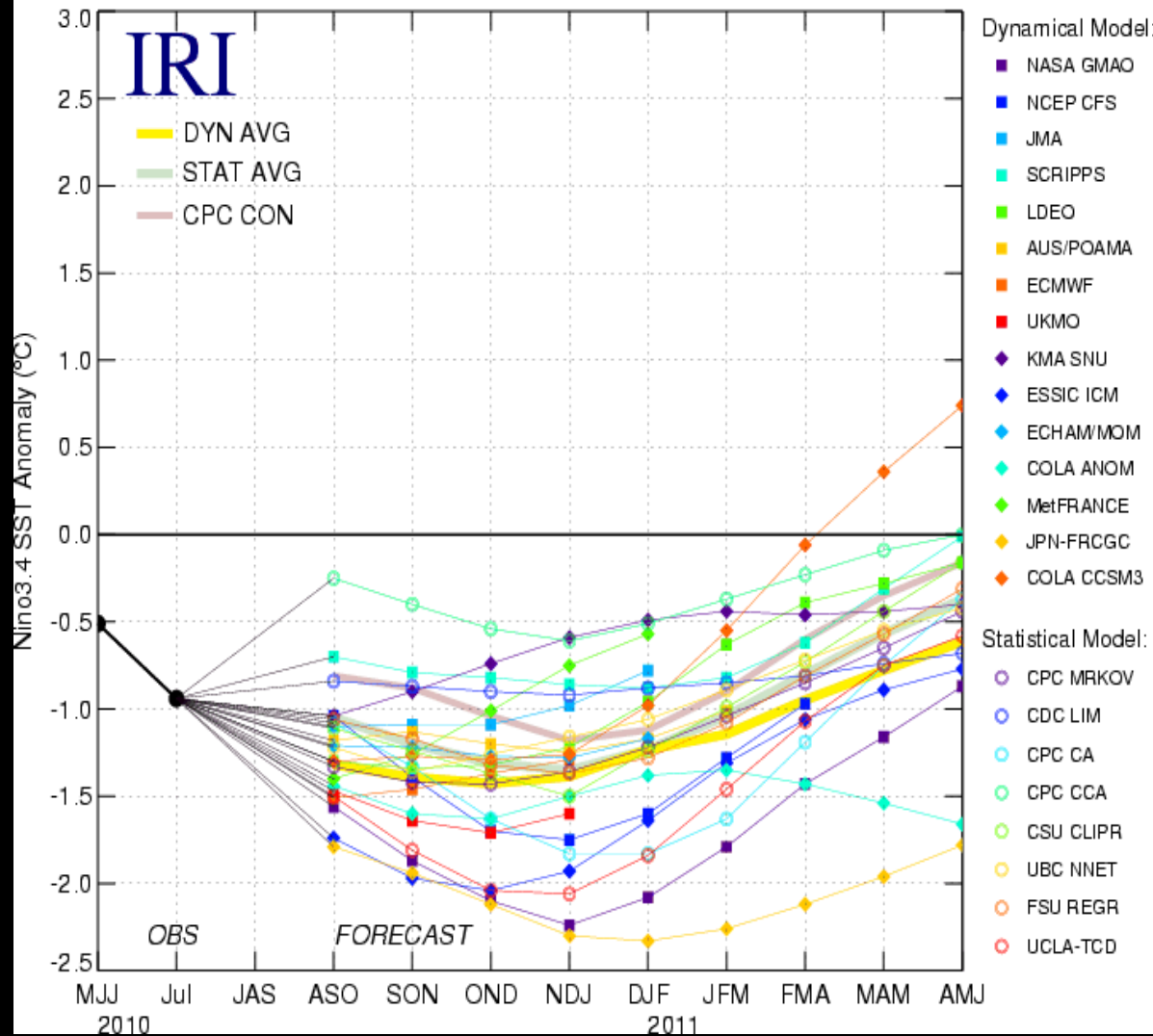
Cold Episodes - La Niñas (In Blue): ONI of -0.5 and below

Neutral Episodes -non-ENSO (In White): ONI above -0.5 and below 0.5

Not yet determined

# Pacific Niño 3.4 SST Outlook

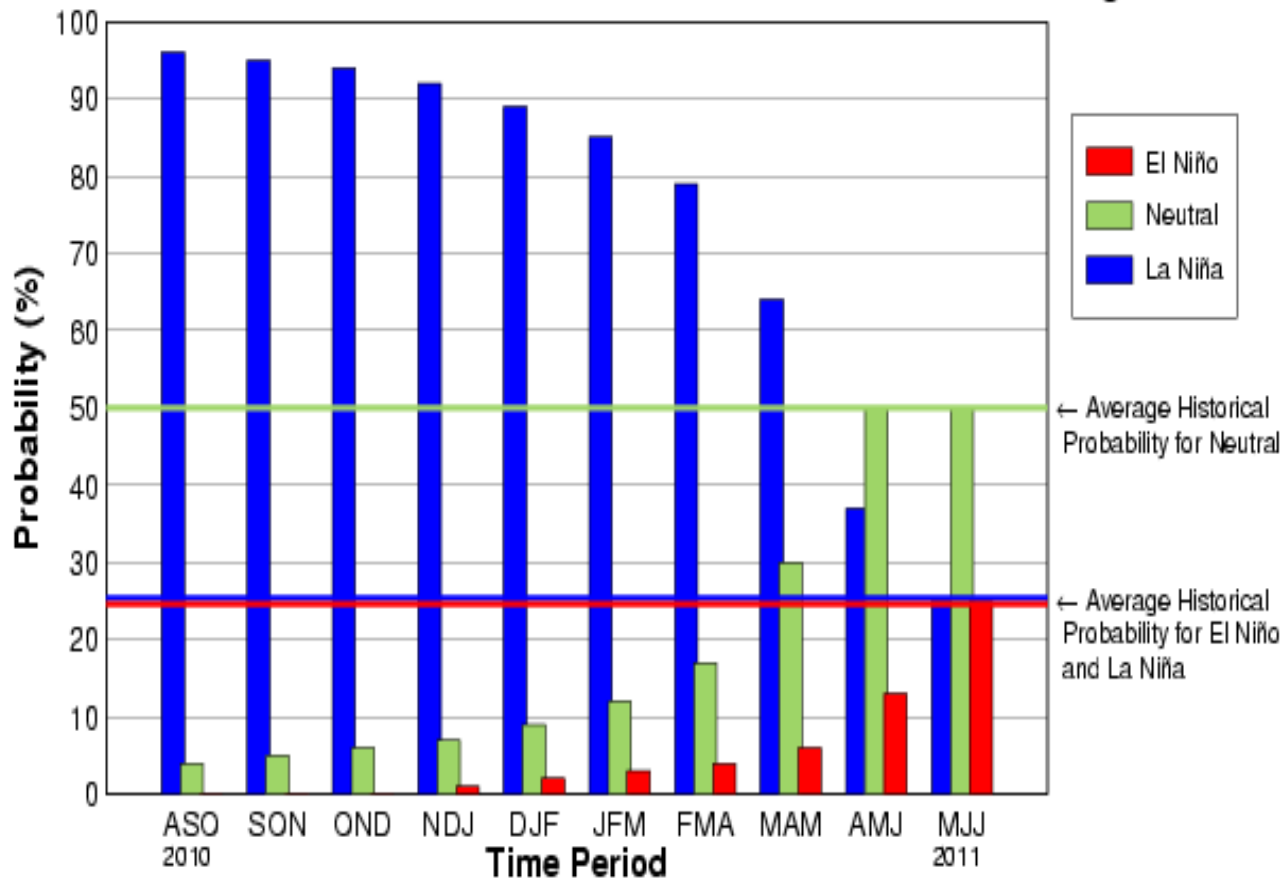
Model Predictions of ENSO from Aug 2010



- All 23 dynamical and statistical models indicate that La Niña conditions (Niño-3.4 SST anomalies - 0.5 C or less) will persist at least through the Northern Hemisphere winter 2010-11. A majority of the models forecast La Niña will strengthen during the next few 3-month climate seasons.

Figure provided by the International Research Institute (IRI) for Climate and Society (updated 18 August 2010).

## IRI Probabilistic ENSO Forecast for NINO3.4 Region



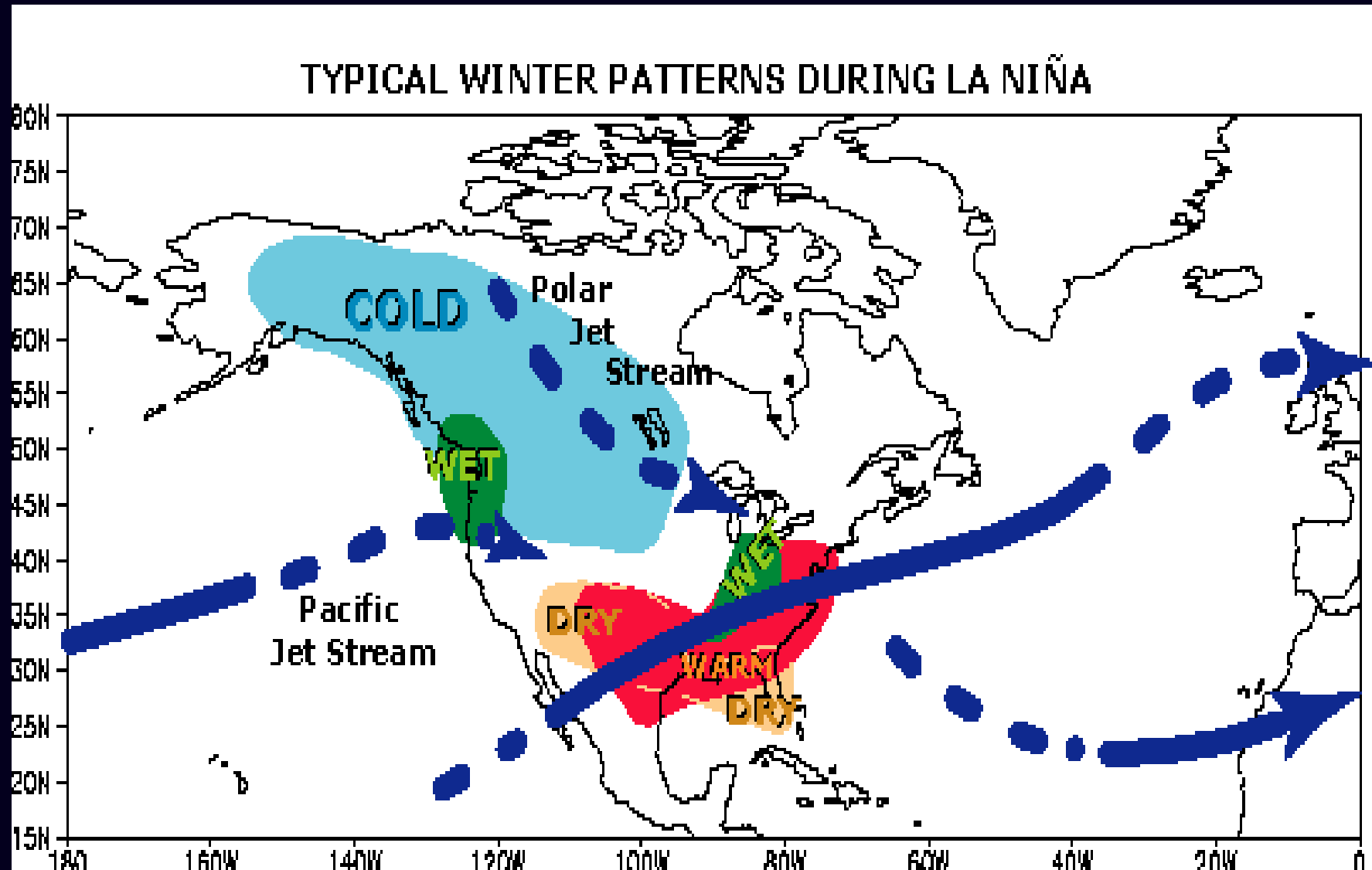
Issued Aug 2010

This table from IRI shows a greater than 90% probability that the current La Niña will persist in the Niño 3.4 Region at least through the 2010-11 December-January-February climate period.

The probability of La Niña, El Niño and non-ENSO or neutral conditions for the next nine 3-month climate periods



# Typical North American Temperature, Precipitation and Jet Stream Patterns during La Niña Winters



Source: NOAA/Climate Prediction Center

# Typical Jet Stream Pattern and Seasonal Weather Conditions Observed Across the U.S. During Moderate to Strong La Niñas



Mike Baker National Weather Service Boulder

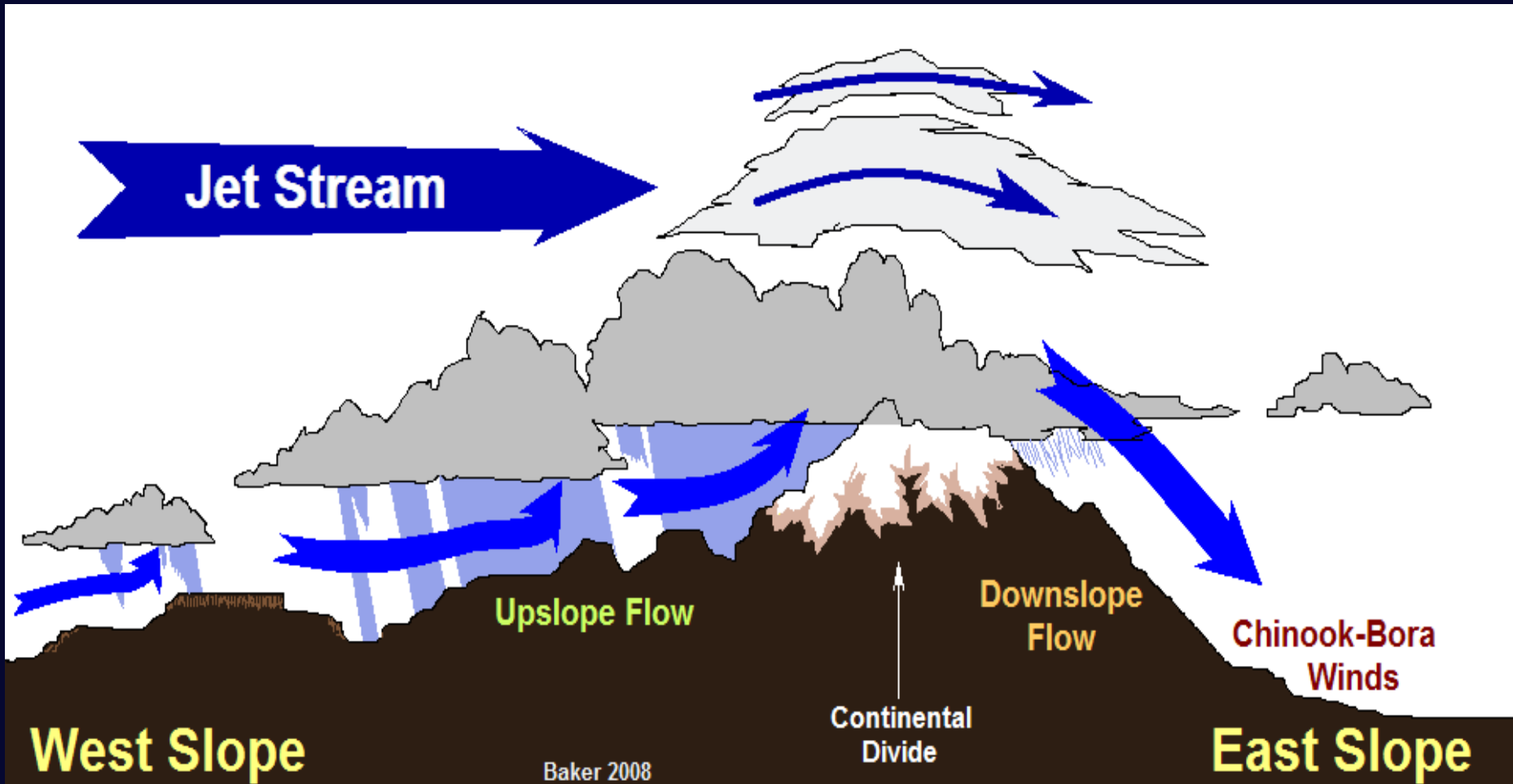


Above to much normal  
sea surface temperature



Below to much below normal  
sea surface temperature

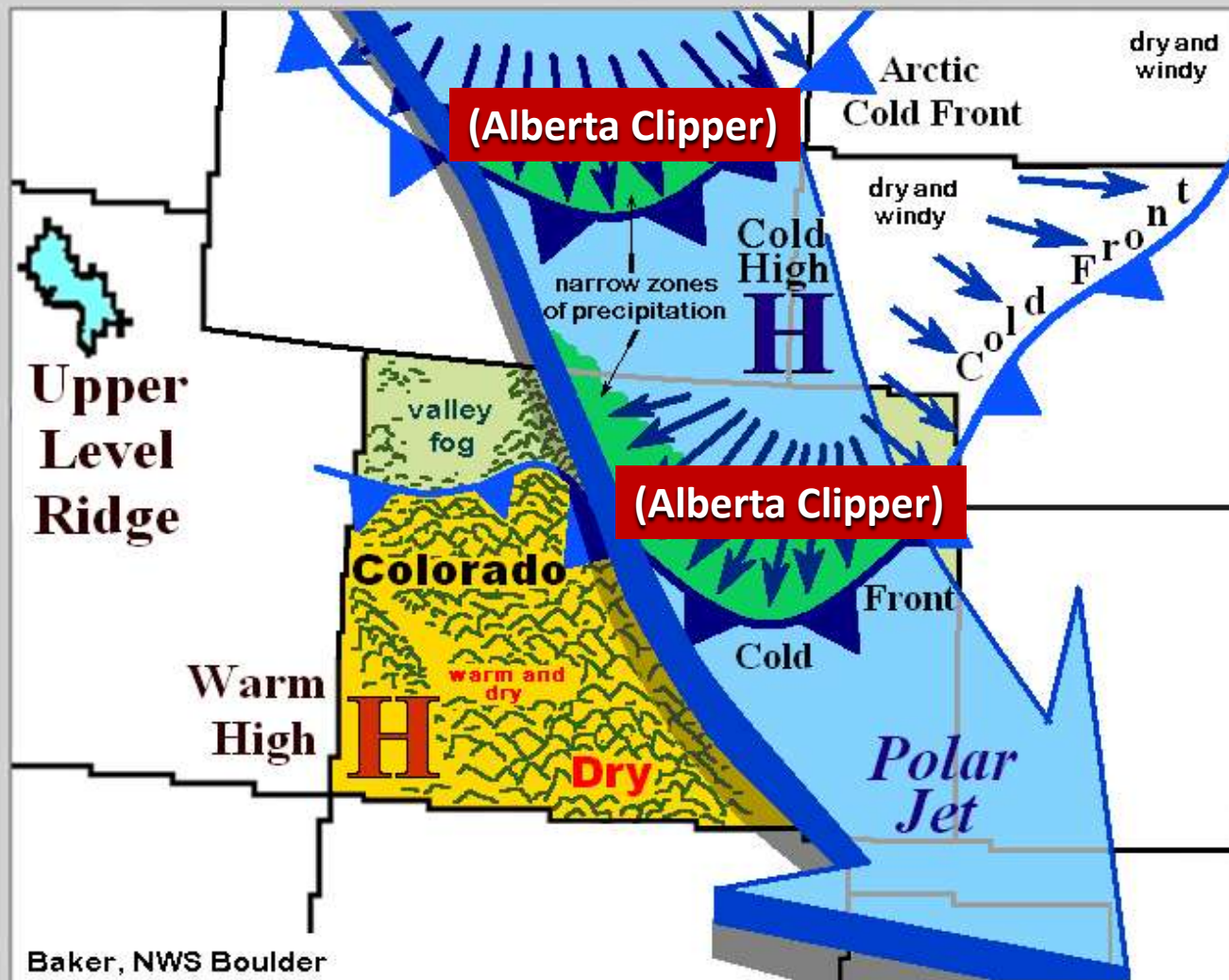
# Strong Influence of Mountainous Terrain on Colorado Weather



Windward facing mountain slopes generally see greater precipitation, cooler temperatures and higher humidity values than leeward facing slopes. Downslope winds such as the Chinook can produce abnormally warm and dry conditions, such as along the face of the Colorado Front Range during the late winter and spring of moderate to strong La Niñas.



# Mean Position of the Polar Jet Stream During Late Summer through Mid-Autumn of Moderate to Strong La Niña Episodes

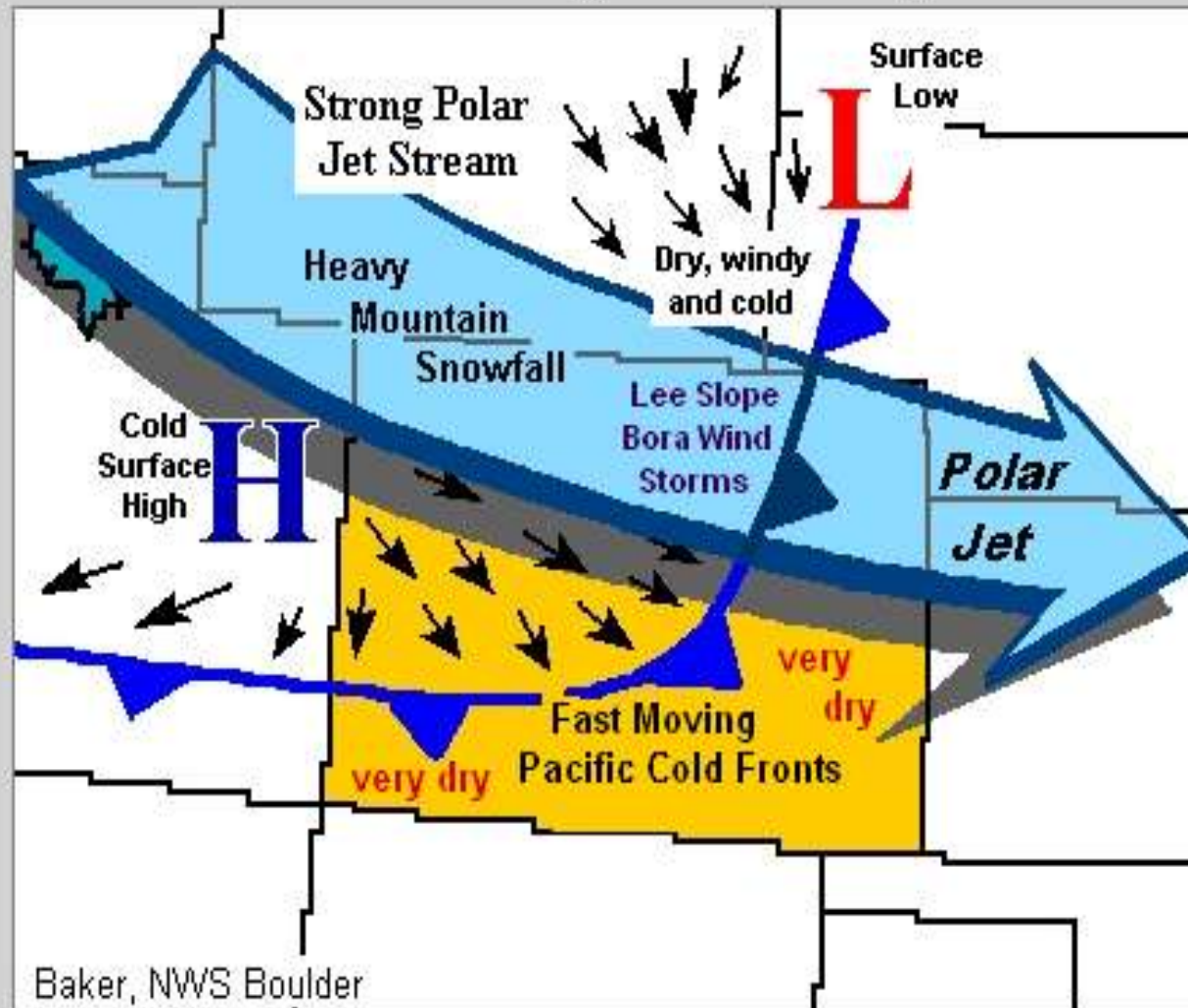


Eastern Colorado often sees a greater number of cold fronts, occasionally referred to as "Alberta clippers" during the late summer and autumn with the Polar jet stream angled as such across the state during La Niña episodes.

These fast moving frontal systems are often accompanied by narrow bands of precipitation, sometimes with great intensity, strong and gusty northerly winds, and bitter cold air marked by a sudden drop in temperature with passage of the front.



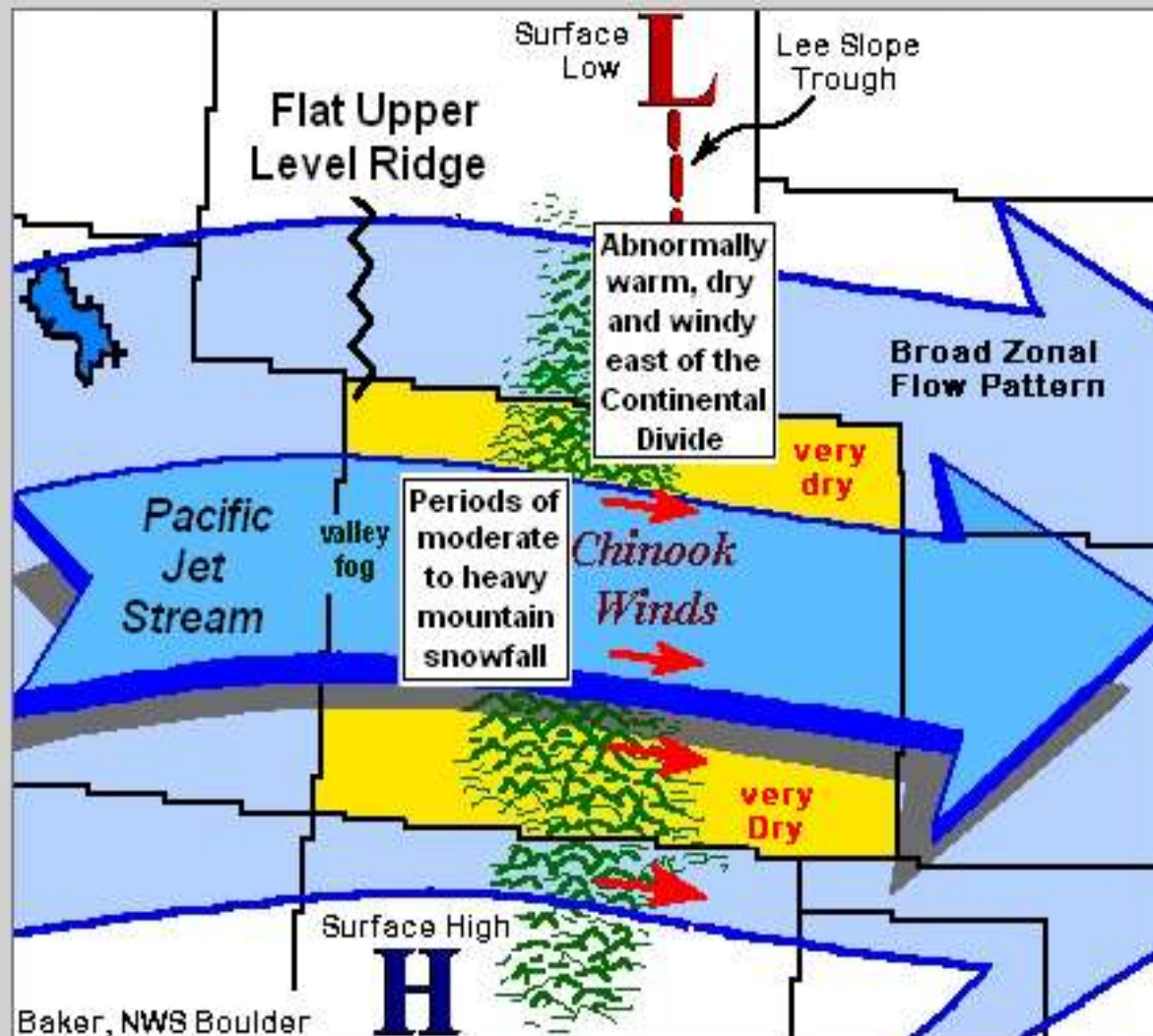
# Mean Position of the Polar Jet Stream During Late Autumn through Mid-Winter of Moderate to Strong La Niña Episodes



As the west coast high pressure ridge weakens and flattens, the Polar jet stream acquires more of a west-northwesterly component.

This southward shift in the jet results in an increase, often a significant increase, in precipitation and wind across the northwest plateau and north central mountains of Colorado.

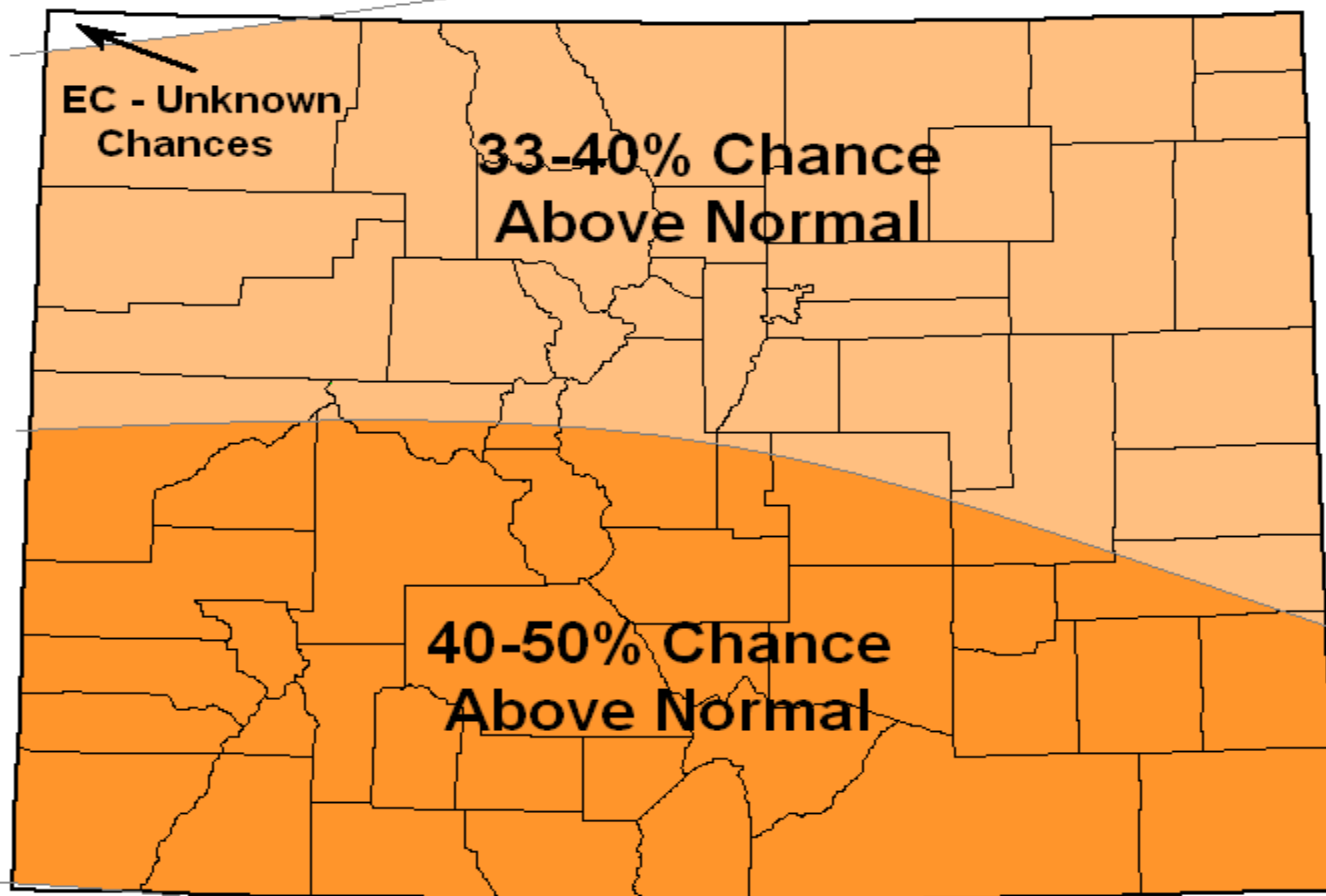
# Mean Position of the Polar Jet Stream From Mid-Winter through the Spring During Moderate to Strong La Niña Episodes



In late winter and spring during the stronger La Niña episodes, the prevailing flow aloft usually becomes predominantly zonal or westerly in direction. This generally warmer and drier flow pattern still manages to produce periods of moderate to heavy snowfall on west facing mountain slopes along and west of the Continental Divide.

Whereas in areas east of the Divide, the weather is often abnormally warm, windy and quite dry for days, if not for weeks at a time.

# September-October-November 2010 Temperature Outlook for Colorado



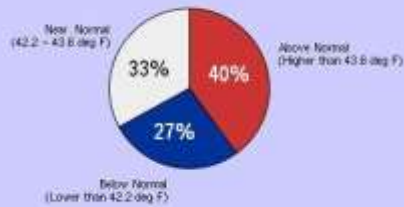
3-Month Temperature Outlook  
0.5 Month Lead  
Issued Aug 19 2010

**Latest  
Temperature  
Outlook for  
Colorado  
From NOAA's  
Climate  
Prediction  
Center**



# COLORADO

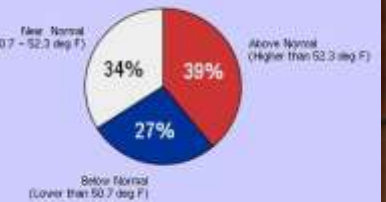
Sep-Oct-Nov 2010 Temperature Outlook  
Estes Park, CO



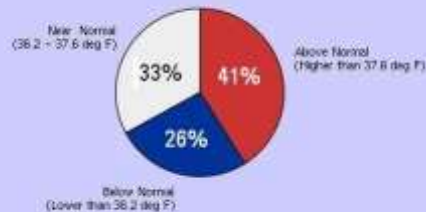
Sep-Oct-Nov 2010 Temperature Outlook  
Denver, CO



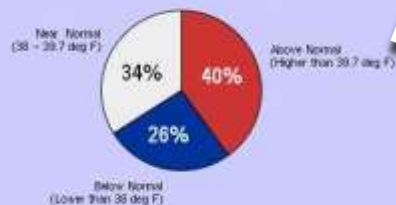
Sep-Oct-Nov 2010 Temperature Outlook  
Sterling, CO



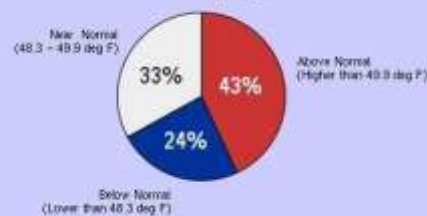
Sep-Oct-Nov 2010 Temperature Outlook  
Grand Lake, CO



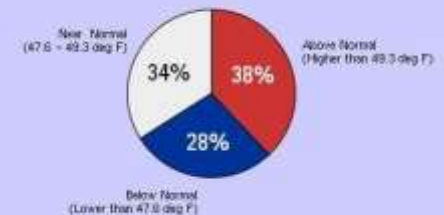
Sep-Oct-Nov 2010 Temperature Outlook  
Green Mountain Reservoir, CO



Sep-Oct-Nov 2010 Temperature Outlook  
Colorado Springs, CO

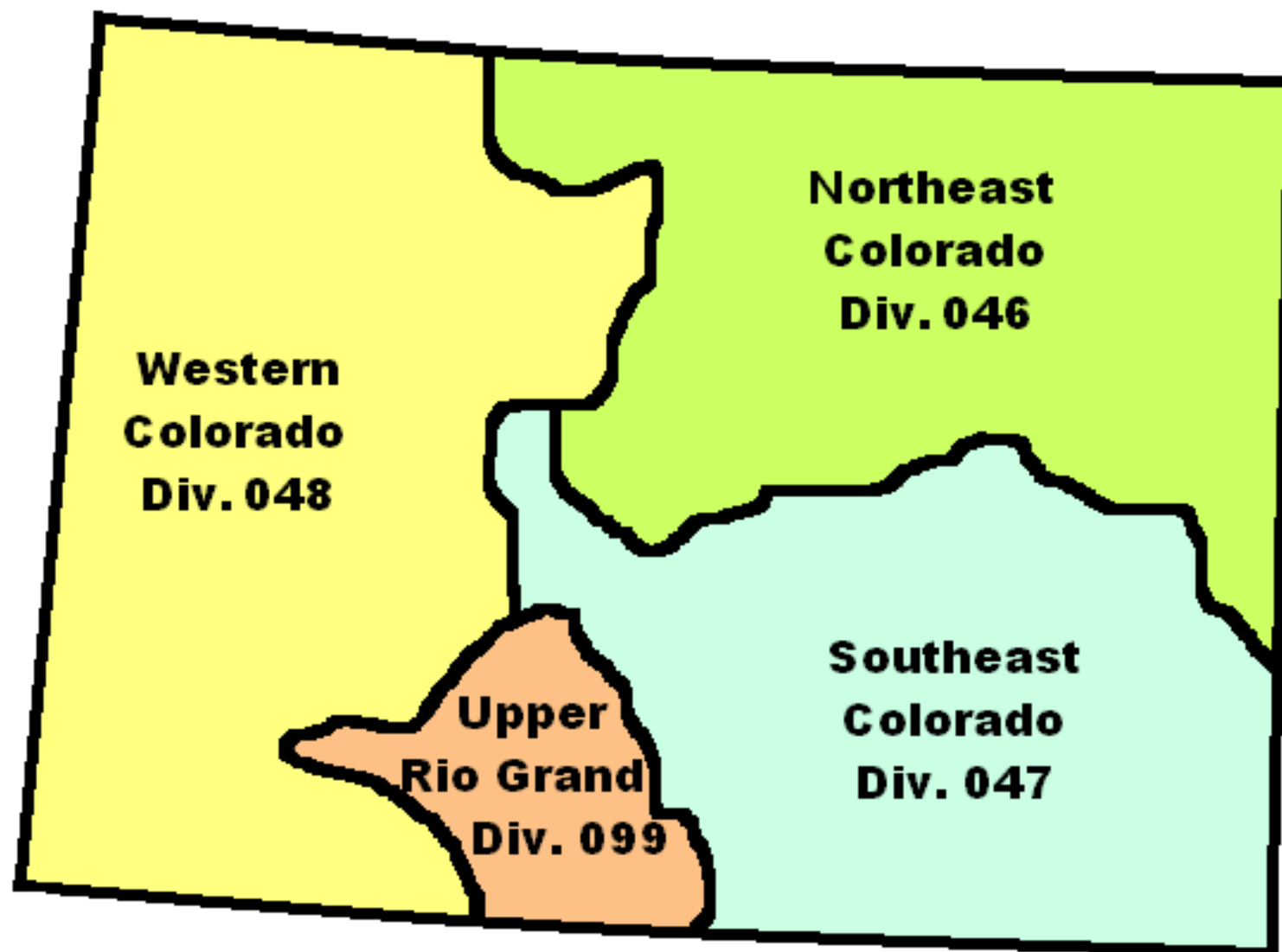


Sep-Oct-Nov 2010 Temperature Outlook  
Byers, CO

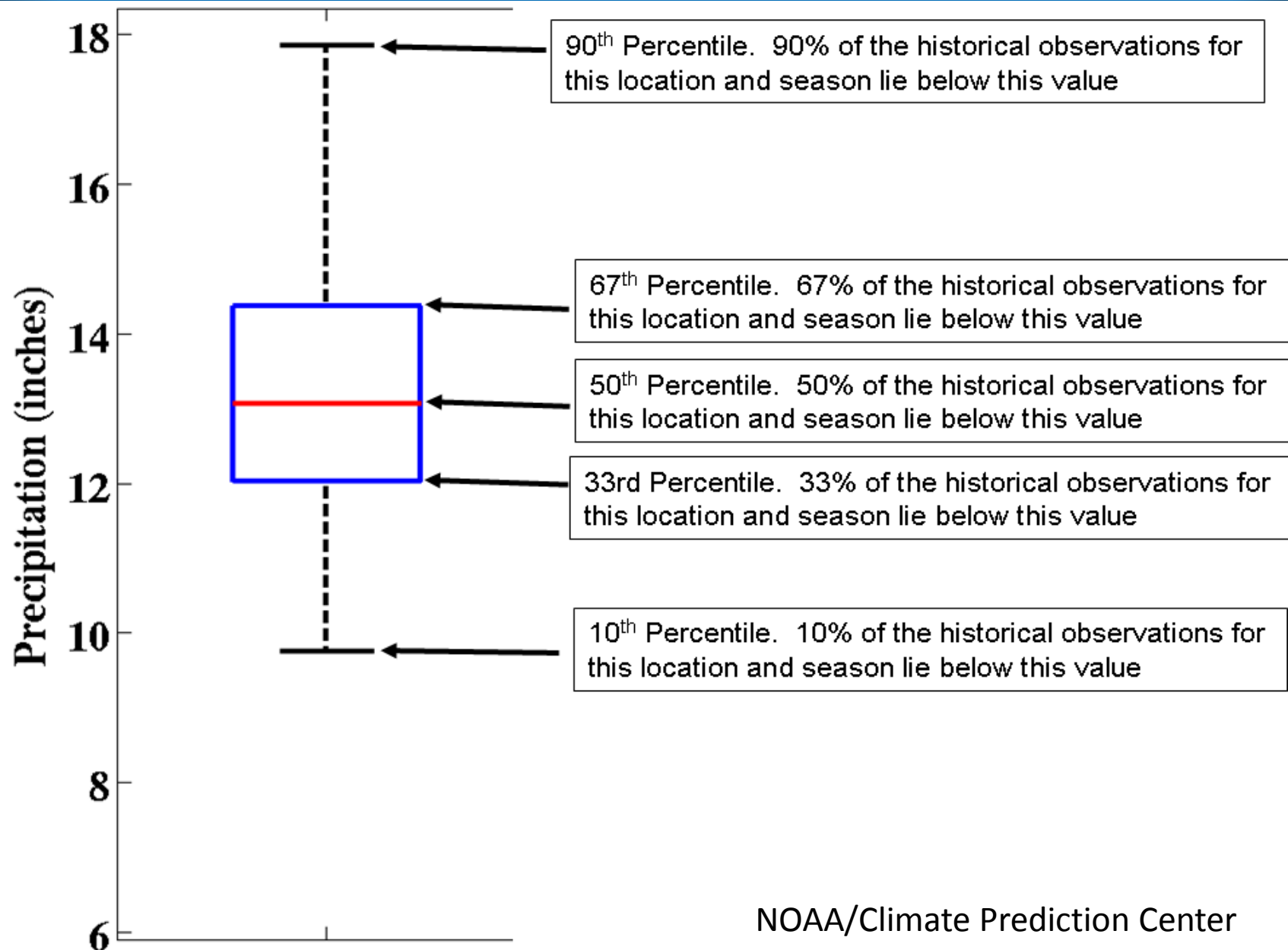




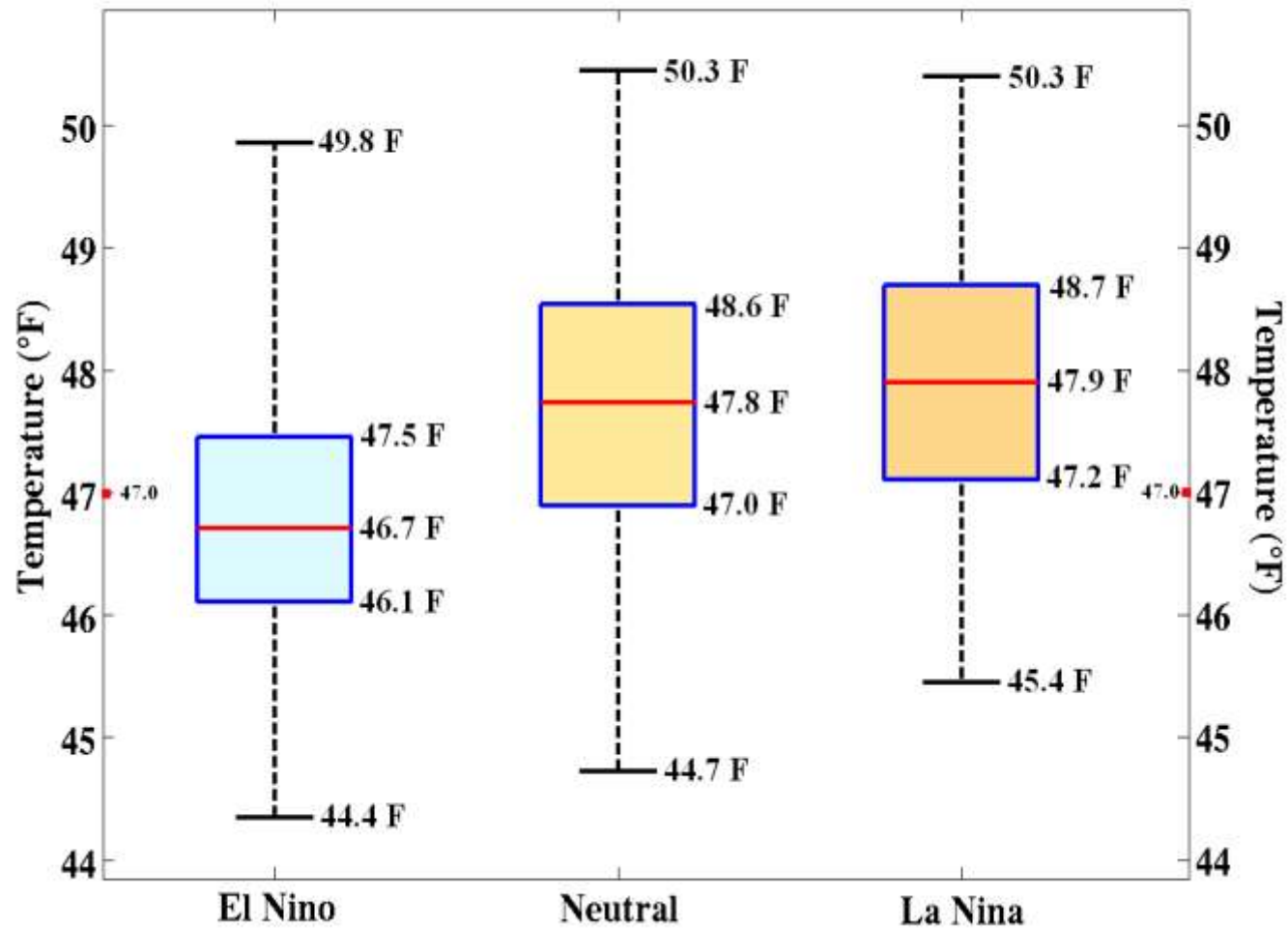
# Colorado Climate Divisions



# CPC Whisker Plots



**September-October-November Temperature Distribution for Climate Division #046  
South Platte River Basin in Northeast Colorado**

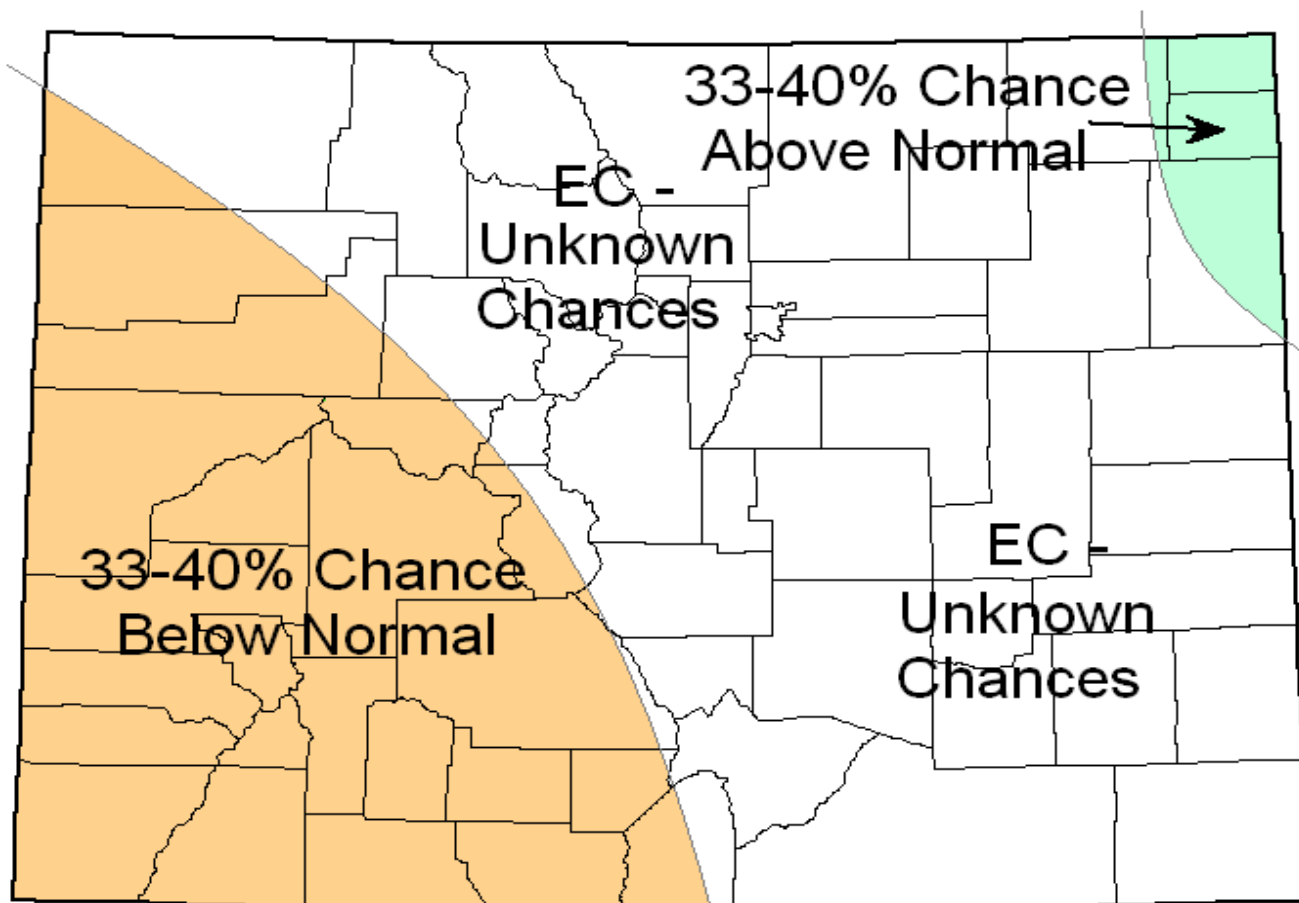


Baker NWS Boulder

NOAA/CPC

Since 1950, northeast Colorado has climatologically been warmer than average during La Niña episodes, and also warmer than that observed during El Niño episodes. Temperatures during neutral or non-ENSO periods were similar to those during La Niñas.

**September-October-November 2010 Precipitation Outlook  
for Colorado**

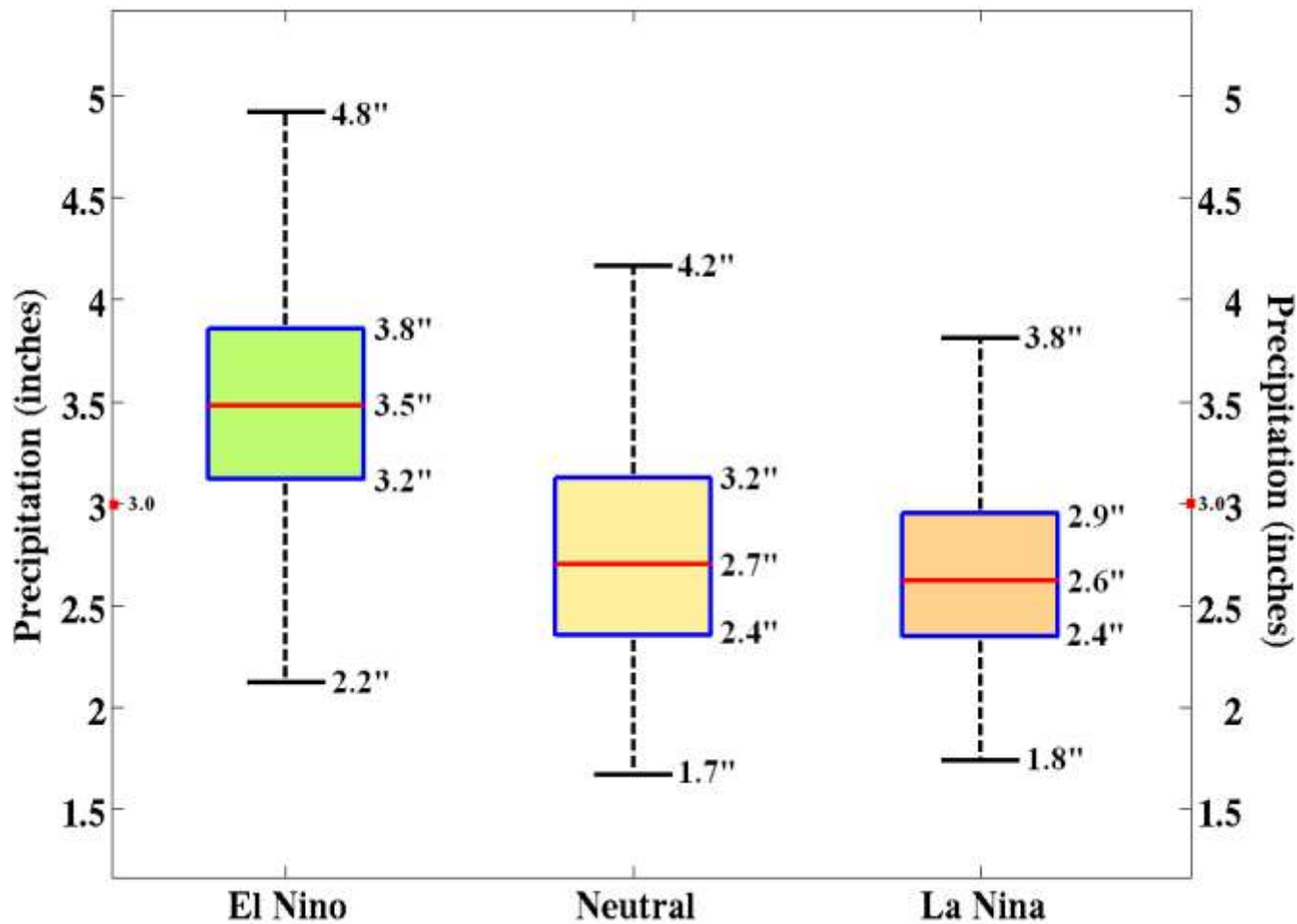


3-Month Precipitation Outlook  
0.5 Month Lead  
Issued Aug 19 2010

**Latest  
Precipitation  
Outlook for  
Colorado  
From NOAA's  
Climate  
Prediction  
Center**



**September-October-November Precipitation Distribution for Climate Division #046  
South Platte River Basin in Northeast Colorado**

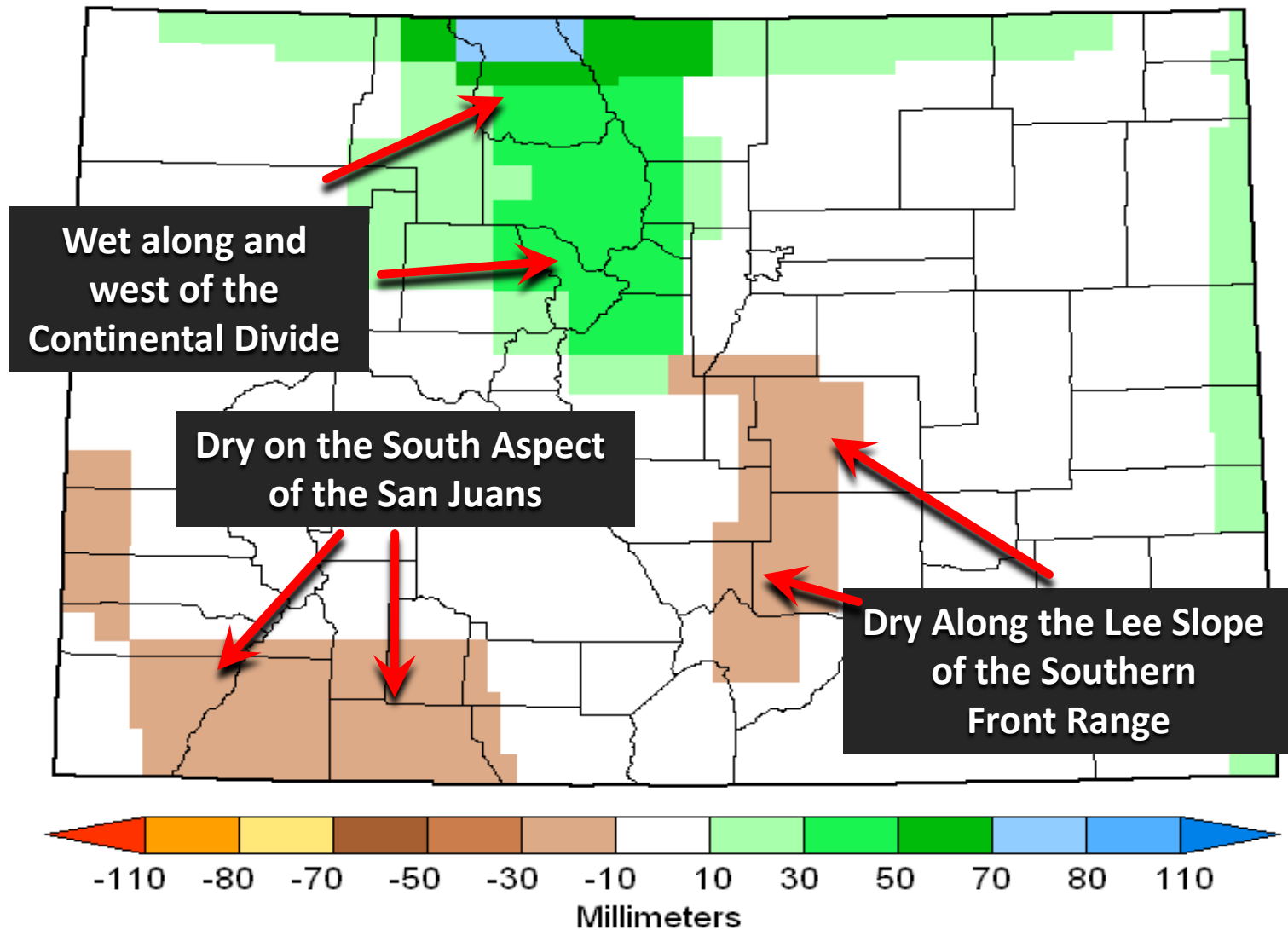


Baker NWS Boulder

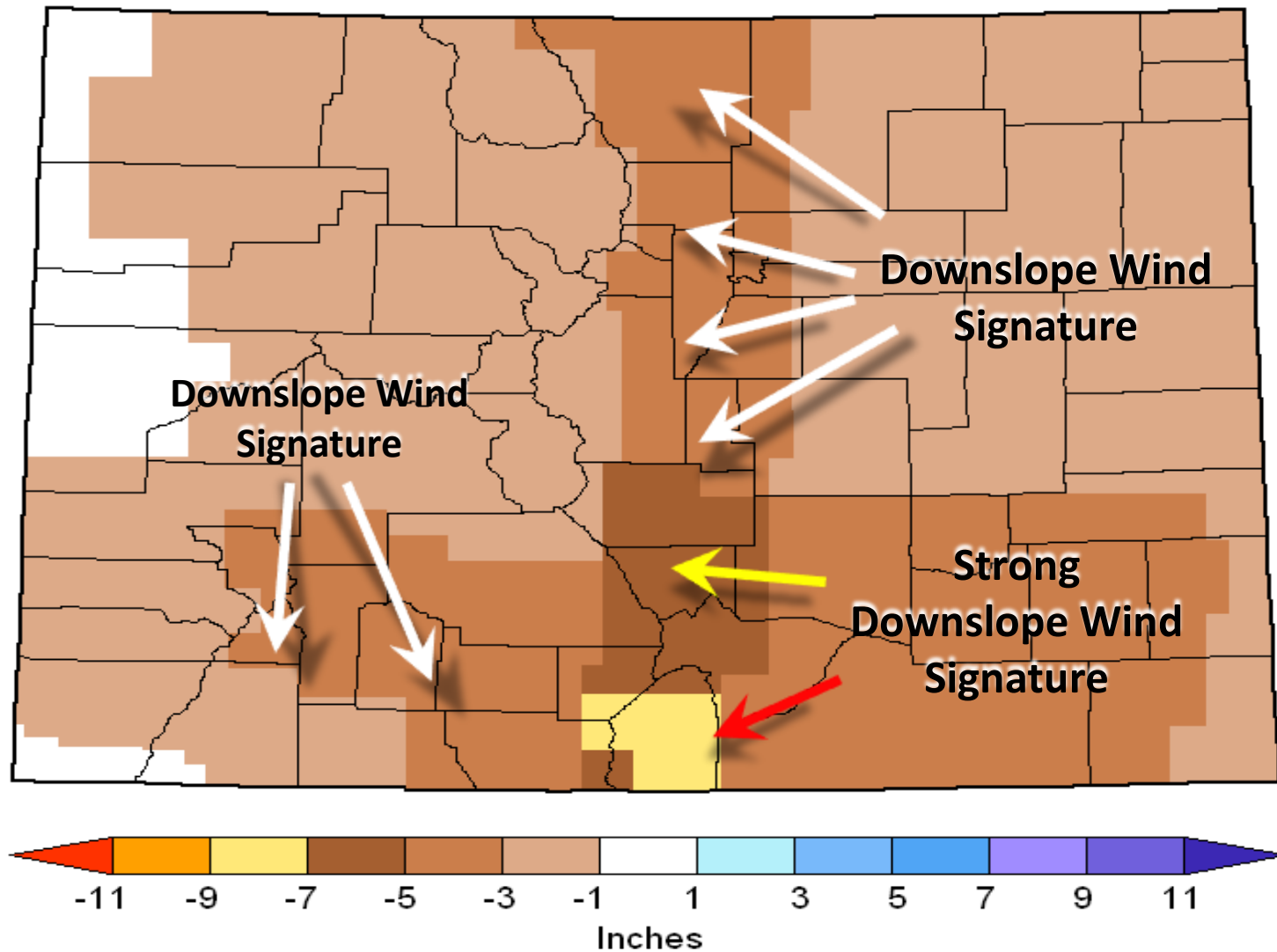
NOAA/CPC

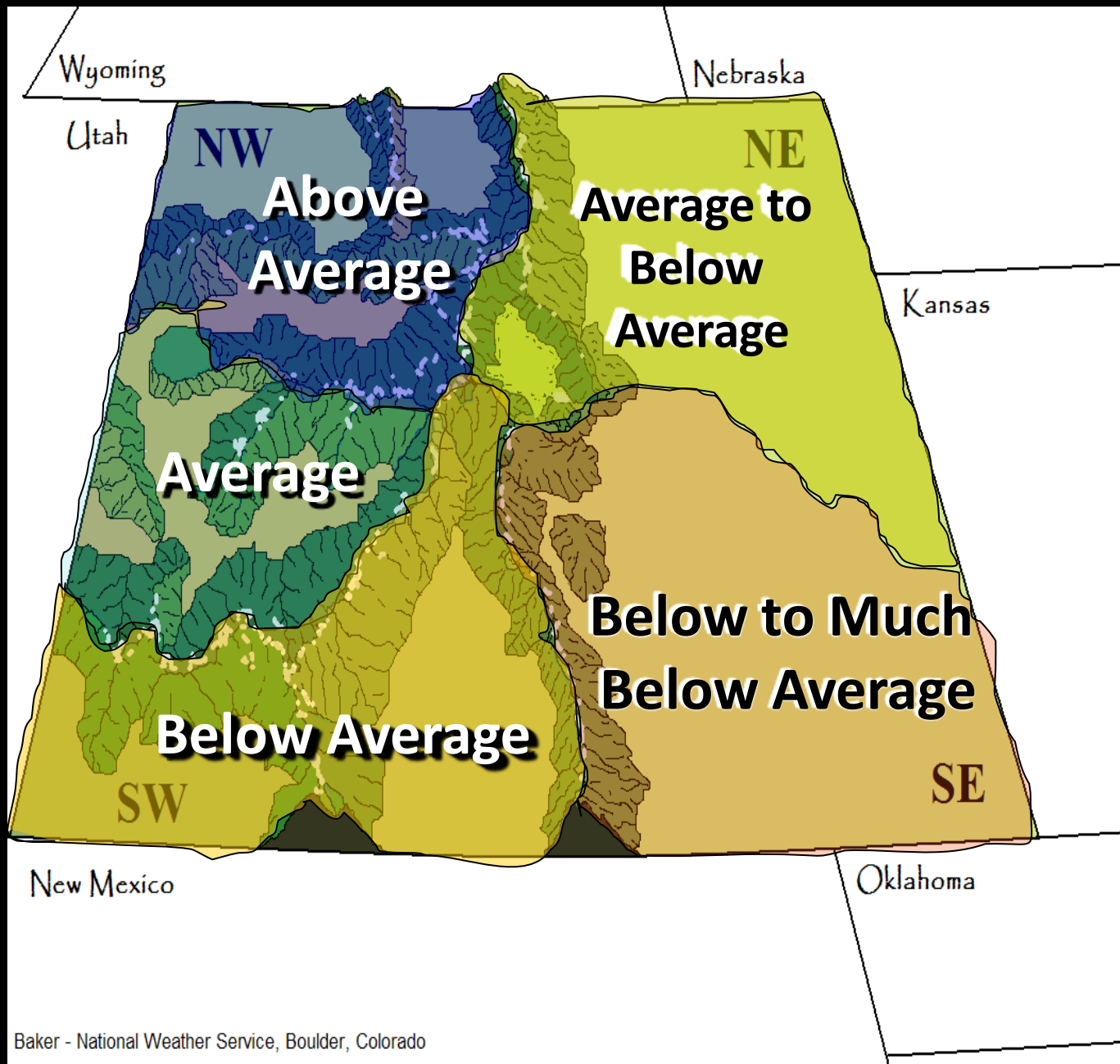
Since 1950, northeast Colorado has climatologically been drier than average during La Niña episodes, and also drier than that observed during El Niño episodes. Precipitation during neutral or non-ENSO periods was similar to that during La Niñas.

September-October-November La Niña Precipitation Anomalies (In mm)  
Composite + Trend for Colorado



September-October-November La Niña Snow Anomalies (In Inches)  
Composite for Colorado





## Typical Winter Season Precipitation Patterns During La Niñas

West central and northwest Colorado typically receives **AVERAGE** to **ABOVE AVERAGE** precipitation (rain and snow) during moderate to strong La Niñas, particularly from mid-winter through mid-spring.

Whereas, southwest and eastern Colorado typically receives **BELOW** to **MUCH BELOW AVERAGE** precipitation (rain and snow).

# Summary

**La Niña conditions are present across the eastern tropical Pacific.**

**Equatorial SSTs are as much as 1 to 4 degrees Celsius below average from the Date Line eastward to the South American coast.**

**Recent equatorial Pacific SST trends and model forecasts indicate La Niña will continue at least through the winter of 2010-2011.**

**The current La Niña is forecast to produce above average temperatures and below average precipitation across most of Colorado...specifically southern and eastern portions of the state at least through the upcoming winter season.**

**Meanwhile the northwest and north central sections of Colorado are expected to see above average precipitation (snowfall) and below average temperature. These conditions are more likely to exist during the latter half of the winter season and perhaps into the spring of 2011 should the present La Niña episode continue.**